

FILLED CELL CONCRETE MASONRY HIGH LIFT GROUTING METHOD

IR 21-2

Reference: California Building Code, Section 2104A.6

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Supercedes IR 24-4 (9/89)

This interpretation is intended for use by the plan review and field engineers of DSA to indicate an acceptable method for achieving compliance with applicable codes and regulations. Its purpose is to promote more uniform statewide criteria for use in plan review and supervision of construction of public schools, community colleges and essential services buildings. Other methods proposed by design professionals to solve a particular problem may be considered by DSA and reviewed for code and regulation compliance.

Purpose: The purpose of this IR is to provide the requirements and procedure for high lift concrete masonry grouting when the use of this method is approved by the Division of the State Architect (DSA).

1. Description. The high lift grouting method as developed for use in reinforced concrete block masonry is intended for use on wall construction where openings, block pattern arrangements, special reinforcing steel, or embedded structural steel details do not prevent the free flow of grout or inhibit the use of mechanical vibration to properly consolidate the grout fill in all cells or horizontal grout spaces. Horizontal reinforcing should be positioned in a single vertical plane at each curtain of steel to allow maximum accessibility to the cell spaces.

The high lift method requires that all masonry units, reinforcing steel and embedded items will be in place before grouting of the wall commences. The work should be so arranged that once grouting of a section of wall is started the grouting shall proceed in lifts without stopping, except as noted below until the full height of the prepared section is poured. The waiting period between lifts shall be limited to the time required to obtain an initial consolidation of grout due to settlement, shrinkage and absorption of excess water by the masonry units. This also allows for a reduction in hydrostatic pressure of the grout on the masonry unit and reduces the possibility of "blow-outs."

The grout shall be a high-slump workable mix, preferably placed by pumping to permit continuous pouring. The grout shall be worked into all voids. Mechanical vibrators shall be used for consolidation. Where job conditions preclude such use, other methods may be employed if approved in advance, by DSA. Because of the high water/cement ratio used in this type of grout, it is essential that the grout be reconsolidated after it has taken on a plastic consistency, but prior to taking an initial set. The reconsolidation is intended to overcome settlement shrinkage, separation from the reinforcing steel and to promote bond to the masonry unit walls.

For the purpose of this IR, a "pour" is considered as the entire height of grout fill placed in one day and is composed of a number of successively placed grout lifts. A "lift" is the layer of grout placed in a single continuous operation.

The maximum height of pour is limited by the practical considerations of segregation of grout due to the height of free fall, effect of dry grout deposits left on block projections and reinforcing steel and the ability to effectively reconsolidate the grout. Unless specifically approved otherwise, the maximum height of pour will be 12 feet for eight inch (8") walls and 16 feet for 12" walls. For height of lift see Item 4 (9.) of this IR.

2. Quality of Materials. All materials are to conform to CBC, Section 2102A, with the following additional requirements:

1. Pea Gravel. Pea gravel for grout is to conform to ASTM C404-87, Aggregates for

Masonry Grout, except when other gradations are specifically approved by the architect or structural engineer and DSA.

2. Coarse Aggregate. Coarse aggregate is to conform to CBC, Section 1903A.3.
3. Admixture. The grout should contain an admixture of the type that reduces early water loss to the masonry units and produces an expansive action in the plastic grout sufficient to offset initial shrinkage and promote bonding of the grout to all interior surfaces of the masonry units. Obtain the approval of the architect or structural engineer and DSA for use of the admixture.

3. Mortar and Grout.

3.1 Mortar. Mortar is to comply with the requirements of CBC, Section 2103A.3, with the following additional requirements:

1. Place approximately half of the required water and sand into the mixer while running.
2. Add cement and the remainder of the sand and water into the mixer in that order and mix for a period of at least two minutes.
3. Add lime and continue mixing as long as needed to secure a uniform mass.
4. The total mixing time may not be less than ten (10) minutes.

3.2 Grout. The grout mix is to comply with the requirements of CBC, Section 2103A.4.

Sufficient water may be added to make a workable mix that will flow into all voids of the masonry without separation or segregation. When grout is to be placed in masonry units with typical rates of absorption, the slump of the grout should be approximately nine to ten inches (9"-10") depending on temperature and humidity conditions.

Where the least lateral dimension of cells to be filled exceeds five inches, a coarser aggregate may be used in the grout fill if the mix is designed in accordance with CBC, Section 1905A. The maximum size of aggregate shall not exceed one inch. The water per sack of cement may be greater than is shown in CBC, Table 19A-A-8 to allow for absorption by the masonry units and with sufficient workability to meet the requirements given in the paragraph above.

Grout mixes are to contain an approved admixture conforming to the requirements of Item 2 (3.) above. Use such admixture strictly in accordance with the manufacturer's instructions.

3.3 Mixing of Grout. The mixing of grout is to conform to the requirements for mixing of concrete, CBC, Section 1905A.8. Whenever possible mix and deliver grout in accordance with the requirements for transit-mixed concrete.

Time the admixture addition in strict accordance with the manufacturer's instructions. The procedure used for adding the admixture to the grout mix should provide for good dispersion.

3.4 Tests. Testing of mortar and grout is to conform to the requirements of CBC, Sections 2105A.4 and 2105A.5.

4. Construction. The construction of high lift concrete block masonry work is to conform the requirements of CBC, Chapter 21A, with the following additional requirements:

1. Foundations. The contact surface of all foundations and floors that are to receive masonry work are to be thoroughly cleaned and roughened in accordance with CBC,

Section 1906A.4 before start of laying. Protect the roughened surface during construction to assure a good bond between the grout fill and the concrete surface.

2. Cleanouts. Provide cleanout openings for all walls at the bottom of each pour in accordance with CBC, Section 2104A.6.1.2.3. The openings are to be made prior to start of laying and be of sufficient size and location to allow thorough flushing away of all mortar droppings and debris.

After the laying of the masonry units is completed, the cells cleaned, the reinforcing positioned and inspection completed, close the cleanouts by inserting face shells of masonry units or covering the openings with forms. Face shell plugs are to have a two-day minimum curing time and be adequately braced to resist the pressure of the fluid grout.

3. Reinforcement. Place all reinforcing steel accurately in strict accordance with the approved plans and specifications. Both horizontal and vertical reinforcing are to be held in position by wire ties or spacing devices near ends and at intervals not exceeding 192 diameters of the reinforcement. Place the horizontal reinforcing as the work progresses. The vertical reinforcing may be dropped into position after the completion of the laying if adequate positioning devices are provided to hold the reinforcement in proper location.
4. Masonry Units. Use of open-end concrete masonry units is preferred, wherever possible, and is required for stacked bond. Open-end bond-beam units are to be used wherever possible to facilitate the horizontal flow of grout. Bond-beam units are required at all horizontal bars to provide a minimum vertical opening at all cross webs three inches high by three inches wide.

The concrete masonry units need not be wetted before laying except in dry areas where the contact surfaces of the units should be moistened immediately before laying to prevent excessive drying of mortar.

5. Laying. Fill all head and bed joints solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Care shall be taken in placing the mortar to keep a minimum of droppings from falling into the block cells. Arrange open-end concrete masonry units used in stacked bond so the closed ends are not abutting.
6. Wall Ties and Bracing. When stacked bond is used, or when adequate cross webs between face shells are not provided, ties of heavy gage wire embedded in the horizontal mortar joints should be provided across continuous vertical joints or between face shells to prevent "blow-outs" due to the hydrostatic pressure of the fluid grout. External ties or braces may also be used for this purpose.

During construction, brace the ungrouted walls adequately to resist wind and other forces.

7. Mortar Droppings and Overhangs. Thoroughly remove all mortar droppings and overhangs from the foundation or bearing surface, cell walls and reinforcing. An acceptable method is by providing a two or three inch blanket of dry sand over the exposed surface of the foundation, dislodging any hardened mortar from the cell walls and reinforcing with a pole or rod and removing the mortar debris with the sand cover prior to clean up and grouting.

8. Construction Joints. In the high lift grouting method, intermediate horizontal construction joints are not permitted. Plan the work for one continuous pour of grout to the top of the wall in four foot layers or lifts in the same working day. Should a blow-out, a breakdown in equipment, or any other emergency occur, cease the grouting operation. An alternate procedure may be used with the approval of the architect or structural engineer and DSA.

The section of wall to be grouted in any one pour is limited to a length in which successive lifts can be placed within one hour of the preceding lifts. Vertical control barriers shall be placed between pour sections in locations approved by the architect or structural engineer and DSA.

9. Grouting. To prevent "blow-outs," pour no grout until the mortar has been set and cured. However, grout the walls as soon as possible after mortar has cured to reduce shrinkage and cracking of the vertical joints. All cleanout closures, reinforcing, bolts and embedded connection items are to be secured in position before grouting is started.

Handle grout from the mixer to the point of deposit in the grout space as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry unit surfaces not being immediately encased in the grout lift. Depending upon weather conditions and absorption rates of the masonry units, the lift heights and waiting periods may be varied. Under normal weather conditions, with typical masonry units, the individual lifts of grout are limited to four feet in height with a waiting period between lifts of 30 to 60 minutes.

Place the first lift of grout to a uniform height within the pour section and mechanically vibrate thoroughly to fill all voids. The grouting team should be organized to enable the vibration to follow closely behind and at the same pace as the pouring operation.

After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift should be poured and alternate cells vibrated twelve inches to eighteen inches into the preceding lift. Do this in such a manner as to reconsolidate the preceding lift and close any plastic shrinkage cracks or separations from the cell walls.

If, because of unavoidable job conditions, the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding lift, reconsolidate each lift by reworking with the mechanical vibrator as soon as the grout has taken its settlement shrinkage.

Repeat the waiting, pouring and reconsolidation steps until the top of the pour is reached. Reconsolidate the top lift after the required waiting period to fill any space left by settlement shrinkage.

10. Cleaning Wall. Immediately after the wall has been fully grouted, hose off with water under pressure through a jet nozzle, to remove all the scum and stains which have percolated through the blocks and joints.
11. Curing. Attention should be given to proper curing of the mortar joints as well as the grout pour. The concrete block work and top of the grout pour should be kept damp to prevent too rapid drying during hot or dry weather, and drying winds.

5. Inspection and Core Tests.

5.1 Inspection. All masonry work is required to be continuously inspected during laying and grouting by an inspector specially approved for that purpose by the DSA. The inspector makes test samples and performs such tests as are required by Item 3, 4 above.

The special masonry inspector checks the materials, details of construction and construction procedure. The inspector shall furnish a verified report that of his own personal knowledge the work covered by the report has been performed and materials use and installed in every particular in accordance with and in conformity to the duly approved plans and specifications.

5.2 Core Tests. Take core tests of the completed masonry construction in accordance with CBC, Section 2105A.3.1.

The owner's inspector or testing agency is to inspect the coring of the masonry walls and prepare a report of coring operations. State in this report the number, the location and the condition of all cores cut on the project. Pay particular attention to the description of the bond between the grout fill and the cell walls of the masonry unit. The report should also include a description of any difficulties encountered in the coring operation which might impair the strength of the sample.

Submit all cores to the testing laboratory for examination.

One half of the cores shall be tested for the bond strength of the joint between the masonry units and the grout. This test determines the unit force required to shear the masonry unit face shells from the grout core for each face.